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depth pressure of 85 Mega Pascals. Up to twelve fibres are envisaged gas blocked through a single gland.

(28) A big advantage is the use of acrylate-coated fibres which are not stripped for use in the gland. Other coatings could however be used and the acrylate coating can be overcoated with a further plastics coating if desired, provided a gas-blocking coating is maintained.

(29) The embodiments described are filled with the gas blocking material from one end, ie. the HP end before the hydraulic pressure resisting plug 13 at the LP end is formed, which means that the plug 13 is not independently testable to ensure its integrity. The embodiment of FIG. 7 provides for independent testing of the plug before completion of the gland with gas blocking material.

(30) Referring to FIG. 7, a gland body 30 has a bore 31. A tube 32 fits concentrically into the body 30 so there is an annular space 33 between the outer surface of the tube 32 and the bore 31 of the body, except at the right hand end as viewed in FIG. 7 where the end portion 32A of tube 32 is an interference fit in a reduce diameter portion 31A of bore 31. The optical fibre 34 extends through the tube 32. A cap 35 is screwed onto a threaded end portion 30A of body 30 and an O ring is compressed against the end face 30B of body 30 and also seals against the fibre 34. Then resin is injected through port 35A until resin appears from the end 35B of cap 35, and the resin cured at room temperature. This forms the hydraulic pressure resisting plug of the gland and this can be tested with gas pressure from the high pressure end.

(31) Then the gas blocking material (Hyvis-RTM) is injected through port 30C in body 30, which travels through the space 33 until it reaches two diametrically opposed slits 32B at the left hand end which allows the material to enter the bore of the tube 32 and travel back to the high pressure HP end.

(32) A small length of heat shrink tubing (not shown) is applied over each end of the gland and the protruding fibre to provide a bend limiting device and a liquid seal for the gas blocking material. Prior to application of the tubing a metal sleeve 36 is applied over the port 30C to prevent leakage.

(33) This design is intended in this embodiment for a single fibre and the length of the gas block is about 25 mm and the length of the resin block about 10 mm.

(34) It is an important advantage in all embodiments that the fibre or fibres do not have to be stripped. The compatibility of the resin with the fibre coating is of course important.

(35) In all the embodiments the hydraulic pressure resisting plug comprises an adhesive material which is bonded both to the coating of the or each fibre and to the wall of the passageway through which the fibres extend, and the integrity of the bond needs to be such as to prevent leakage of the gas

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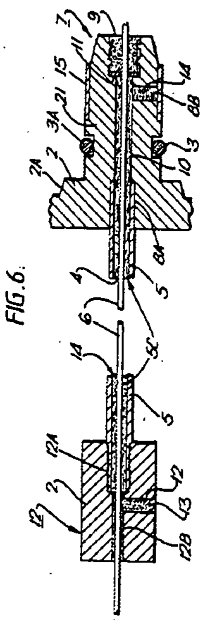


FIG. 6.

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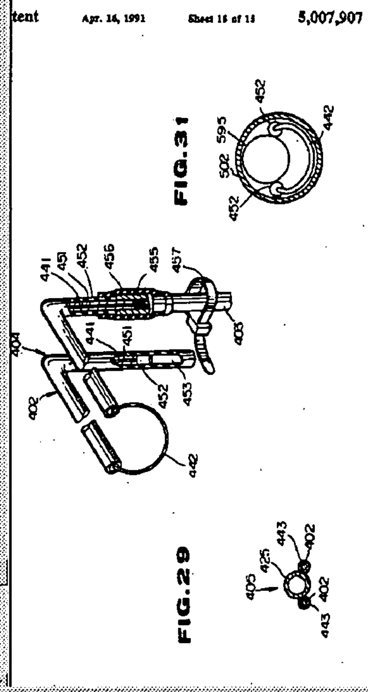
mentioned cord part 403 so that the cord part 403 and the high frequency current source not illustrated may be electrically and mechanically connected with each other.

(115) The above mentioned body 407 is shown in FIGS. 25 and 26. The resecting handle 401 can be water-tightly and removably connected with such sheath 502 as is shown in FIG. 25 by a tapered part 415 of a connecting part 414 formed in front of the body 407 and a pin 416 (See FIG. 23). By the way, the above mentioned sheath 502 comprises an elongate hollow tube part 506a insertable into a body cavity and a sheath body 506 consisting of a tubular body connected to this hollow tube part 506a at the base end and communicating with the interior of the above mentioned hollow tube part 506a. The above mentioned sheath body 506 is provided with a water feeding port 507 for injecting a liquid. The hollow tube part 506a is fitted at the tip with a beak 508 made of an insulating material. In the rear of the above mentioned connecting part 414, as shown in FIG. 26, a cover 419 of a substantially square cross-section having a groove 418 having steps 417 and having a rectangular cross-section opened downward is extended to an optical sighting tube connecting part 420 formed at the rear end of the optical sighting tube inserting part 405. A lower finger hanger 421 is provided to project downward from the vicinity of the connecting part 414 so that the middle finger and third finger may be hung in case the resecting handle is held by one hand and an upper finger hanger 422 is provided to project upward so that the index finger may be hung. A spring shaft 424 slidably holding a spring 423 always rearward energizing the slider 406 rearward from the front projects above within the above mentioned groove 418. A guide pipe tube 425 is extended to the optical sighting tube connecting part 420 through the connecting part 415 from the front of the connecting part 415 below within the groove 418. In the optical sighting tube connecting part 420, an optical sighting tube inserting hole 426 having substantially the same inside diameter as of the guide pipe 425, O-ring 427 and O-ring presser 428 fixing this O-ring 427 are adjacently provided in the rear of the guide pipe 425 so that the optical sighting tube 595 may be inserted through the guide pipe 425 while keeping the water-tightness and the optical sighting tube 595 may be led at the tip to the tip of the resecting handle 401.

(116) The above mentioned slider part 429 consists of a slider front part 429 and slider rear part 430 which are made integral by the engagement of snap fits 431 projecting forward out of the slider rear part 430 and holes 432 formed in the slider front part 429 respectively with each other. The upper contours of the slider front part 429 and slider rear part 430 are substantially the same as of the groove 418. A spring hole 433 through which the spring 423 can be inserted and an optical sighting tube pipe hole 434 through which the optical sighting tube pipe 425 can be inserted are formed through the slider front part 429. A shaft hole 435 through which the spring 423 can not be inserted but only the spring shaft 424 can be inserted and an optical sighting tube pipe hole 436 through which the guide pipe 425 can be inserted are formed through



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optical fiber 18 is inserted into the forming conductor tube. Apparatus 10 has a chamber 20 through which optical fiber or fibers 18 pass. At one end of chamber 20 is pressure seal 22 having opening 24 through which the optical fiber or fibers 18 enter chamber 20. At the opposite end of chamber 20 is apertured nozzle 26. Chamber 20 and nozzle 26 guide the optical fiber or fibers 18 and deposit the fiber or fibers 18 at the throat 28 of forming die 16. Although any suitable technique may be used, in a preferred manner, the optical fiber or fibers 18 are caused to pass through chamber 20 and are inserted into tubular conductor 14 by pulling with any suitable means not shown on one end of the fiber or fibers 18. In this way, optical fiber or fibers 18 are inserted simultaneously with the forming of tubular conductor 14. Tubular conductor 14 may contain any desired number of optical fibers 18. In a preferred embodiment, it contains from one to six optical fibers.

(7) In a preferred embodiment, each optical fiber 18 comprises a photo-conductor glass rod. However, any suitable optical fiber may be used in the cable.

(8) Simultaneous with the tubular conductor being formed and the optical fiber or fibers 18 being inserted into the conductor, a cushioning material 30 is injected into tubular conductor 14 so that the material 30 substantially surrounds the optical fiber or fibers 18. Apparatus 10 has a concentric pressure chamber 32 for inserting cushioning material 30. The cushioning material 30 enters chamber 32 through entry 34, preferably while under pressure. The motion of strip 12 and fiber or fibers 18 in the direction of arrow A causes material 30 to flow through nozzle 36 at one end of chamber 32. The cushioning material 30 is preferably introduced into chamber 32 under pressure so that as cushioning material 30 enters the forming tubular conductor 14, it substantially completely fills the tube and positions fiber or fibers 18. Any suitable mechanism not shown can be used to supply chamber 32 with material 30 under pressure.

(9) The use of cushioning material 30 is highly desirable in a cable which may be subjected to high bending or hydrostatic stresses. Cushioning material 30 has two primary functions. First, it lubricates the fiber or fibers 18 to prevent stiction and microbending. Second, it provides the fiber or fibers 18 with a hydrostatic, ambient pressure environment. In a preferred embodiment, cushioning material 30 comprises a nonsetting void filler such as a gel. However, any suitable non-setting void filler may be utilized.

(10) Strip 12 which is used to form tubular conductor 14 preferably has an initial width greater than the outside circumference of the tube formed by forming die arrangement 16. The initial width is about 5% to about 15%, preferably about 10%, greater than the tube outside circumference. By starting with such an initial strip, the seam 38 created during tube forming will be put into significant compression, thereby remaining substantially closed even if spring back occurs.



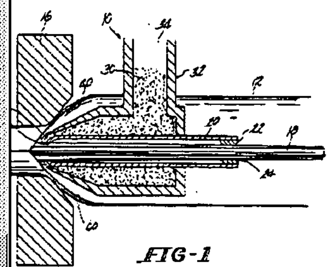

FIG-1

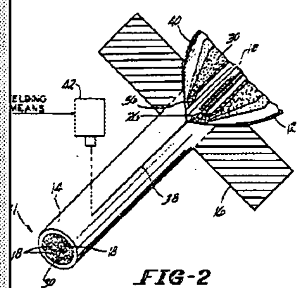

FIG-2

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(8) Application of one or more than one layer of helically wound bare elongate elements of metal or metal alloy around the central core may be effected in tandem with the operation of forming the central core or it may be effected as a separate operation or separate operations. Feeding of the or each advancing optical fibre into the space bounded by the U-shaped elongate member and injection of greasy water-impermeable medium into the elongate compartment are preferably effected using at least one substantially rigid tube having an external diameter which is less than the internal diameter of the elongate compartment, which rigid tube is positioned in the space bounded by the U-shaped elongate member and extends beyond the means by which the U-shaped elongate member is transversely folded or otherwise shaped to form the central core, the or each advancing optical fibre being fed into the upstream end of the rigid tube and greasy water-impermeable medium being injected through at least one port in the wall of the tube, excess water-impermeable medium flowing out of the downstream end of the tube and in an upstream direction between the U-shaped elongate member and the rigid tube and out of the U-shaped member. Preferably, excess greasy water-impermeable medium flowing out of the downstream end of the tube and in an upstream direction between the U-shaped elongate member and the tube and out of the U-shaped member is collected in a reservoir positioned beneath the U-shaped member. Greasy water-impermeable medium being injected through at least one port in the wall of the rigid tube, preferably is fed from a storage tank, the pressure and rate of flow of water-impermeable medium from the storage tank into the tube being manually or automatically controlled. The storage tank, rigid tube and reservoir positioned beneath the U-shaped member may form part of a circulatory system, water-impermeable medium collected in the reservoir from the U-shaped member being pumped back into the storage tank. Preferably, the pressure and rate at which greasy water-impermeable medium is injected into the rigid tube are such that water-impermeable medium, flowing towards the downstream end of the tube, draws the or each optical fibre along the tube and into the elongate compartment of the advancing U-shaped elongate member.

(9) The rigid tube may have in its bore guide means for positioning a single optical fibre within the elongate compartment or two or more circumferentially spaced guide means for positioning two or more optical fibres in circumferentially spaced positions within the elongate compartment. The water-impermeable medium substantially filling the elongate compartment will serve to some extent to maintain a single optical fibre in the compartment spaced from the wall of the compartment or two or more optical fibres in the compartment circumferentially spaced with respect to one another although it will still permit relative movement between the optical fibres and the stranded body when required. The rigid tube may be caused to rotate about its longitudinal axis so that the optical fibres fed into the elongate compartment each follows a helical path, or the rigid tube may be caused to oscillate about its longitudinal axis so that the optical fibres being fed into the elongate compartment each follows a helical path whose direction of lay reverses at spaced positions along the length of the stranded body.